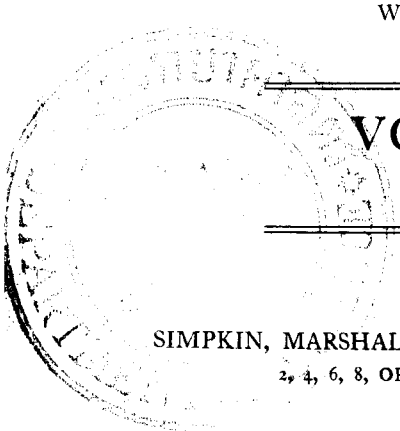
THE ANALYST:

THE ORGAN OF THE

Society of Public Analysts and other Analytical Chemists

A MONTHLY JOURNAL DEVOTED TO THE ADVANCEMENT OF ANALYTICAL CHEMISTRY



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1921

THE ANALYST.

PROCEEDINGS OF THE SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS.

ORDINARY MEETING, DECEMBER 1, 1920.

HELD at the Chemical Society's Rooms, Burlington House, Mr. Alfred Smetham, President, in the chair.

A certificate was read for the first time in favour of Mr. W. R. Schoeller, Ph.D.

Certificates were read for the second time in favour of Messrs. Urban Aspey, Herbert Corner Reynard, B.Sc. (London), A.I.C., Edwin Burnhope Hughes, B.Sc. (London), A.I.C., Harry Jephcott, M.Sc. (London), A.I.C., Arnold Lees, A.I.C.

The following was elected a Member of the Society: Mr. T. K. Ghose, B.A., L.M.S. (Cal.).

The President referred to the regret with which the Council had received the resignation of Mr. Julian L. Baker from the Editorship of the ANALYST, a position which he had so ably filled for the last thirteen years, and congratulated him upon his appointment to the Editorship of the *Journal of the Institute of Brewing*.

The President announced that the Council had appointed Mr. C. A. Mitchell as his successor.

The following papers were read: "Estimation of Theobromine," by Raymond V. Wadsworth; "A New Process for the Estimation of Small Quantities of Chromium in Steels," by B. S. Evans, M.B.E., M.C., B.Sc., F.I.C.; "Some Notes on the Reactions between Fulminate of Mercury and Sodium Thiosulphate," by P. V. Dupré, M.B.E., A.C.G.I., F.I.C., and F. H. Dupré.

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OBITUARY NOTICE.

J. W. GATEHOUSE.

MR. J. W. GATEHOUSE died on October 16, 1920, at Bath, at the age of seventy-nine, and we have to mourn the loss of one of our earliest members, whose death snaps one of the remaining links connecting the Society of Public Analysts in its early struggling days with the Society of to-day. He was also an original Fellow of the Institute of Chemistry.

Mr. Gatehouse was educated at Battersea College for the teaching profession, and subsequently became for a time science master at Hereford. Then, in 1868, he settled in Bath, where the rest of his long life was to be spent. For some years he carried on a private practice, in addition to teaching science at Downside College, near Bath, and other well-known schools. Long before the local Technical School was established he started classes for chemistry, botany, electricity, and kindred subjects, and many of his pupils were successful in the South Kensington examinations.

In 1877 Mr. Gatehouse was appointed Public Analyst for the City of Bath, an appointment which he held for over forty years, resigning in 1918. During the earlier years of his appointment he was engaged in many interesting chemico-legal cases, particularly in connection with the question of salt in beer, upon which he became an authority. A paper which he read upon this subject was published in the second volume of the ANALYST. In 1888 he was appointed Public Analyst for Wiltshire, and later became Electric Light Inspector under the Board of Trade and chemist under the Petroleum Acts.

Apart from his official duties, Mr. Gatehouse did much work upon the spectroscopic examination of the gases emanating from the Bath mineral waters, and was probably one of the first to discover that they contained helium, although his results were never published.

In recent years he specialised in the analysis and methods of testing calcium carbide and acetylene, having been official chemist to the Acetylene Association from its inception, and he devised a method and apparatus for estimating phosphorus and sulphur compounds in acetylene. This method was brought before the International Congress for Acetylene in 1894, and has been officially adopted as the standard method by many public bodies.

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REACTIONS OF SUGARS AND POLYATOMIC ALCOHOLS IN BORIC ACID AND BORATE SOLUTIONS, WITH SOME ANALYTICAL APPLICATIONS.

By G. VAN B. GILMOUR, B.Sc. (Lond.), A.R.C.Sc.I., A.I.C.

The property which boric acid solutions exhibit of becoming more acidic on addition of certain polyatomic alcohols and sugars was first pointed out by Klein in 1878 (*Bull. Soc. Chim.*, **29**, 195). The explanation of such reactions was that combinations take place with the production of stronger acids. The subject has since been the source of a large amount of research, which has added very considerably to our knowledge of this type of reaction. It has been found that not only polyatomic alcohols and sugars form such combinations, but also that a large class of hydroxy compounds reacts similarly. The tendency of forming strong or weak complexes depends very largely on the position of the hydroxy groups, and Böseken has stated (*Rec. Trav. Chim.*, 1915, **34**, 96-113) that when these groups are in the same plane and on the same side as the two carbon atoms to which they are bound, the position is favourable for condensation.

Early investigators stated that the polysaccharides failed to give positive reactions. Thomson (*J. Soc. Chem. Ind.*, 1893, **12**, 432-433) obtained a positive reaction with cane-sugar, and the author has shown that lactose and maltose react in like manner. Thomson (*loc. cit.*) applied the reaction to a volumetric method of estimating boric acid. He found that in the presence of glycerol boric acid could be titrated to the compound $NaBO_2$. He tried to replace glycerol by dextrose and cane-sugar, with unsuccessful results; in these cases the indicator showed up before sufficient alkali was added to convert the acid into metaborate. Vedam (*J. Pharm. Chim.*, 1898 [vi.], **8**, 109-111) used mannitol in this titration; he considered that a sharper end-point was obtained with mannitol than with glycerol.

The increase in electrical conductivity imparted to boric acid solutions by the addition of polyhydroxy bodies is a measure of the stability of the compounds formed. The addition of mannitol has a very marked positive effect compared with glycerol, and this is reflected in the proportional parts of mannitol to glycerol required in the titration of a given quantity of boric acid; twelve times more of the latter than of the former must be present.

The author has been able to titrate boric acid successfully in the presence of lævulose, dextrose, and cane-sugar. Other very soluble sugars will probably act like these, but it was found impossible to carry out the titration with lactose. Weak combinations require a large excess of the hydroxy compound, otherwise the complex is hydrolysed before the proper end-point is reached. At 3 per cent. concentration dextrose, cane-sugar, lactose, and maltose have practically no influence on the acidity of boric acid compared with lævulose, which was found at this concentration to have a very powerful positive reaction, the effect on the acidity being of the same order as that of mannitol.

Ageno and Valla (*Gazetta*, 1913, **43**, 11, 163-174) from solubility measurements considered that boric acid and mannitol unite in equimolecular proportions. More

recently Grun and Nossoivitsch (*Monatsch.*, 1916, **37**, 409-423) have prepared salts of complex bodies formed by the union of boric acid with mannitol, sorbitol, and dulcitol. There can be no doubt that similar compounds are produced by combination with the sugars. The author has prepared the sodium derivative of a complex formed from lævulose and boric acid by a method similar to that used by Grun and Nossoivitsch (*loc. cit.*). The constitution of this compound is being determined.

Reactions between Mannitol, Boric Acid, and Caustic Soda.

An explanation of these reactions, which agrees with the observations of Kahlenberg and Schreiner (*Zeitsch. physikal Chem.*, 1896, **20**, 547-568) and of Magnanini (*Gaz. Chim.*, 428-440, **21**, 134-145), is as follows:

On addition of considerable excess of mannitol to a solution of boric acid, a union takes place in equimolecular quantities (Ageno and Valla, *loc. cit.*) to produce mannito-boric acid, $C_6H_{12}O_6.BOH$. When caustic soda is added to this, the sodium salt is formed, which is stable in acid solution, but in neutral or alkaline solution in the presence of mannitol it is readily hydrolysed into sodium metaborate and mannitol. The former is not stable in solution, and when liberated it immediately satisfies its residual valency by attracting whole mannitol molecules to form with them compounds like $NaBO_2.3C_6H_{14}O_6$. In the volumetric estimation of boric acid the author has found that the minimum quantity of mannitol or lævulose required to enable the acid to be titrated to the metaborate is approximately three molecules of either for one of the acid. These observations, together with the knowledge that the compound trimannitol sodium metaborate, $NaBO_2.3C_6H_{14}O_6.5H_2O$, had been prepared (Grun and Nossoivitsch, *loc. cit.*), led to the above explanation being put forward as to what happens when boric acid solutions are titrated in the presence of mannitol. Fructose seems to act exactly like mannitol, and, indeed, the type of reactions described might be considered general for polyhydroxy compounds that permit of the volumetric estimation of boric acid, the final state being one molecule of metaborate combined with one or more of the compound.

The acidity imparted to borax solutions by the addition of mannitol is due either to free boric acid, or to a mixture of boric acid and mannito-boric acid, or to mannito-boric acid alone, the final stage depending on the quantity of mannitol added. The following equations will illustrate this, in which the effect of adding two, three, and four molecular proportions of mannitol to one of borax is shown:

$$Na_2B_4O_7 + 7H_2O = 2NaOH + 4H_3BO_3 \text{ (Kahlenberg and Schreiner, } loc.\ cit.).$$
$$2C_6H_{14}O_6 + 2NaOH + 4H_3BO_3 = 2C_6H_{12}O_6.BONa + 2H_3BO_3 + 2H_2O.$$
$$3C_6H_{14}O_6 + 2NaOH + 4H_3BO_3 = 2C_6H_{12}O_6BONa + C_6H_{12}O_6BOH + H_3BO_3 + 3H_2O.$$
$$4C_6H_{14}O_6 + 2NaOH + 4H_3BO_3 = 2C_6H_{12}O_6BONa + 2C_6H_{12}O_6BOH + 4H_2O.$$

Boric Acid in Milk.

Farrington (*J. Amer. Chem. Soc.*, 1896, **18**, 847) found that when boric acid is added to fresh milk its acidity to phenolphthalein is about four times as great as that of an aqueous solution containing the same quantity of the acid. Earlier in

this paper it has been pointed out that lactose combined with boric acid to produce a stronger acid, and if the table showing the effect of different quantities of lactose on the acidity of a solution of boric acid given in the experimental portion of the paper is consulted, it will be seen that the production of lacto-boric acid satisfactorily explains Farrington's observation.

Catalytic Action of Boric Acid.—Lowenthal and Lenssen (*J. prac. Chem.*, 1862, **85**, 401) stated that boric acid retards the catalytic action of hydrochloric acid in the inversion of cane sugar. Their results were disputed by Arafura (*Mem. Coll. Sci. Eng., Kyoto*, 1909-10, **2**, 229-236), who clearly showed the reverse to be the case. Arafura found that when the concentration of the hydrochloric acid is kept constant the accelerating effect of boric acid increases with its concentration, whereas the influence of boric acid on the catalytic action of hydrochloric acid is practically independent of the concentration of the latter acid.

It is easy to explain these observations of Arafura now that it is known that lævulose forms a strong lævuloso-boric acid. What actually happens is that the boric acid assists the inversion in two ways: firstly, it removes one of the products of inversion in the sense that its properties are altered; and, secondly, it forms a strong acid that assists the action of the hydrochloric acid.

Analytical Applications.—Lævulose can be used in the volumetric estimation of boric acid. On account of the high price of the pure sugar, its use would be prohibitive in such estimations. Invert sugar, on the other hand, is cheaply prepared, and is an excellent substitute. This is strongly recommended as a reagent to replace glycerol or mannitol. To titrate a given amount of boric acid, the minimum quantity of invert sugar required is about double the minimum of fructose.

The observation that cane-sugar and dextrose have practically no effect when present with lævulose, even in considerable excess, has led the author to attempt a method of estimating lævulose by finding to what point a known volume of standard boric acid can be titrated on the addition of a weighed quantity of the lævulose mixture, the acid's equivalent of lævulose being already determined. In the experimental portion of the paper a series of results is given; these are very encouraging, and it is thought that if the method is carefully standardised fairly accurate estimations can be made. A method such as this would be useful in the analysis of cane-syrup and honey, where the reducing sugar is practically all invert. The lævulose estimated in this way after the reducing sugar has been determined should give a figure approximately half that of the latter.

A method for estimating lævulose based on the measurement of the increase in electrical conductivity of boric acid solutions after the addition of lævulose might possibly give more accurate results than those obtained by the above titration method.

Suggested Use of Lævuloso-Boric Acid.—In medicine there are a number of well-known preparations in which the antiseptic properties of borax or boric acid are increased by means of glycerol. There is one preparation, "*Mel Boracis*," made from borax, glycerol, and honey, where the action of the honey has not been understood. The active principle in this preparation is lævuloso-boric acid, $C_6H_{10}O_6BOH$. This acid is very much more powerful than the corresponding glyceryl compound, and it is here suggested that invert sugar-syrup might be used more successfully as

a basis for this type of preparation than glycerol, and, further, for the sake of economy, it should replace honey in "*Mel Boracis.*"

Experimental.—Tables I. to X. show the effect of different amounts of polyatomic alcohols and sugars on the end-points in the titration of deci-molecular solutions of boric acid with deci-normal soda, using phenolphthaleïn as indicator, the end-point in each case being the first distinct pink coloration. When the alcohol or sugar was not neutral the acidity was determined and allowed for.

TABLE I.—GLYCEROL.

C.c. $\frac{1}{10}$ Molecule H_3BO_3.	Grms. of Glycerol.	C.c. $\frac{N}{10}$ NaOH.
10·0	Nil	0·6
,,	2·0	7·8
,,	3·0	9·0
,,	4·0	9·4
,,	5·0	9·6
,,	6·0	9·7
,,	7·0	9·8
,,	8·0	10·0

TABLE II.—MANNITOL.

C.c. $\frac{1}{10}$ Molecule H_3BO_3.	C.c. of Water.	Grm. of Mannitol.	C.c. $\frac{N}{10}$ NaOH.
10·0	Nil	Nil	0·6
,,	,,	0·05	2·0
,,	,,	0·10	3·6
,,	,,	0·15	4·9
,,	,,	0·20	6·0
,,	,,	0·25	7·1
,,	,,	0·30	7·9
,,	,,	0·35	8·6
,,	,,	0·40	9·0
,,	,,	0·45	9·2
,,	,,	0·50	9·5
,,	,,	0·55	9·8
,,	,,	0·60	9·9
,,	,,	0·65	10·0
5·0	,,	0·30	4·9
,,	10·0	,,	4·7
,,	30·0	,,	4·2

TABLE III.—LÆVULOSE.

C.c. $\frac{1}{10}$ Molecule H_3BO_3.	Grm. of Lævulose.	C.c. $\frac{N}{10}$ NaOH.
10·0	Nil	0·6
,,	0·05	2·0
,,	0·10	3·6
,,	0·15	4·6
,,	0·20	6·0
,,	0·25	6·7
,,	0·30	7·6
,,	0·35	8·1
,,	0·40	8·6
,,	0·45	9·0
,,	0·50	9·3
,,	0·55	9·5
,,	0·60	9·8
,,	0·70	10·0

The sugar used above contained approximately 90 per cent. of lævulose, so that the figures in the centre column are 10 per cent. too high.

TABLE IV.—DEXTROSE.

C.c. $\frac{1}{10}$ Molecule H_3BO_3.	C.c. of Water.	Grms. of Dextrose.	C.c. $\frac{N}{10}$ NaOH.
5·0	10·0	Nil	0·3
,,	,,	0·3	0·9
,,	,,	1·0	2·3
,,	,,	3·0	4·0
,,	,,	5·0	4·6
,,	,,	6·0	4·9
,,	,,	7·2	5·0

TABLE V.—CANE-SUGAR.

C.c. $\frac{1}{10}$ Molecule H_3BO_3.	C.c. of Water.	Grms. of Cane-Sugar.	C.c. $\frac{N}{10}$ NaOH.
5·0	10·0	Nil	0·3
,,	,,	0·3	0·3
,,	,,	1·0	0·6
,,	,,	10·0	3·4
,,	,,	15·0	4·0
,,	,,	25·0	4·6
,,	,,	35·0	5·0
,,	15·0	43·0	5·0

TABLE VI.—LACTOSE.

C.c. $\frac{1}{10}$ Molecule H_3BO_3.	C.c. of Lactose.	C.c. $\frac{N}{10}$ NaOH.
5·0	Nil	0·3
,,	5·0	1·7
,,	10·0	2·2
,,	15·0	2·6
,,	25·0	3·0
,,	50·0	3·5
,,	80·0	3·8
,,	140 0	4·1
,,	280·0	4·4
,,	450·0	4·0

Solution used contained 18 grms. of sugar in 100 c.c. of water.

TABLE VII.—MALTOSE.

C.c. $\frac{1}{10}$ Molecule H_3BO_3.	C.c. of Water.	Grms. of Maltose.	C.c. $\frac{N}{10}$ NaOH.
5·0	Nil	Nil	0·3
,,	10·0	1·0	1·6
,,	50·0	10·0	3·1

More titrations with maltose were not carried out because, as the concentration increased, the solution became so dark in colour that the end-point could not easily be determined.

TABLE VIII.—MANNITOL AND DEXTROSE.

C.c. $\frac{1}{10}$ Molecule H_3BO_3.	Grm. of Mannitol.	Grm. of Dextrose.	C.c. $\frac{N}{10}$ NaOH.
10·0	0·1	0·1	4·0
,,	0·2	0·2	6·4
,,	0·3	0·3	8·2
,,	0·5	0·5	9·6

TABLE IX.—LÆVULOSE AND DEXTROSE.

C.c. $\frac{1}{10}$ Molecule H_3BO_3.	Grm. of Lævulose.	Grm. of Dextrose.	C.c. $\frac{N}{10}$ NaOH.
10·0	0·1	0·1	4·0
,,	0·2	0·2	6·5
,,	0·3	0·3	8·1
,,	0·5	0·5	9·6

The lævulose weights are 10 per cent. too high for the same reason as explained in Table III.

TABLE X.—MANNITOL, DEXTROSE, AND CANE-SUGAR.

C.c. $\frac{1}{10}$ Molecule H_3BO_3.	Grm. of Mannitol.	Grm. of Dextrose.	Grm. of Cane-Sugar.	C.c. $\frac{N}{10}$ NaOH.
10·0	0·1	0·1	0·1	4·0
,,	0·2	0·2	0·2	6·5
,,	0·3	0·3	0·3	8·2
,,	0·5	0·5	0·5	9·7

PREPARATION OF INVERT SUGAR REAGENT.

A satisfactory and rapid laboratory method is as follows:

Twenty-five grms. of cane-sugar are heated with 10 c.c. of water in a conical flask until completely dissolved; the solution is boiled for a few minutes. Add 1 c.c. of $\frac{N}{2}$ HCl to the hot solution, and shake well without reheating. Now dilute, cool, and add 1 c.c. of $\frac{N}{2}$ NaOH, making the volume up to 50 c.c. This reagent is neutral and practically colourless, and 3 c.c. will enable 10 c.c. of $\frac{1}{10}$ molecule boric acid to be titrated. The minimum quantities of glycerol, mannitol, and invert sugar required to titrate 1 grm. of boric acid are respectively 128·0, 11·2, and 22·4 grms.

ESTIMATION OF LÆVULOSE.

It was first thought that lævulose might be estimated by determining the volume of a solution of the sugar that must be added to a known volume of an equi-molecular solution of caustic soda and boric acid containing phenolphthaleïn, so as to just discharge the colour. This proved unsatisfactory; the colour faded fairly regularly until near the end-point, when the last trace of pink persisted to remain even after considerable additions of the sugar solution. The quantity of lævulose required to discharge the colour by this method is greater than that necessary to enable the same amount of boric acid to be titrated directly. The method finally arrived at was based on the results of the titrations shown in Tables III. and IX. It is carried out as follows:

To a flask containing a weighed amount of the lævulose mixture are added 10 c.c. of a $\frac{1}{10}$ molecular solution of H_3BO_3 and 0·5 c.c. of 1 per cent. phenolphthaleïn. This is titrated to the first distinct pink by the addition of $\frac{N}{10}$ NaOH; on standing a little while the pink fades, but the first end-point is taken. The lævulose equivalent of the soda added is read off from a table of equivalents already calculated.

Table XI. below gives lævulose equivalents when mixtures such as syrup or honey are being analysed. In this table allowances have been made for the effect of other sugars present on the end-point. For volumes of $\frac{N}{10}$ NaOH intermediate to any two adjacent figures in the table it can be assumed that the lævulose equivalents increase proportionately.

TABLE XI.

Grm. of Lævulose	equivalent to	c.c. $\frac{N}{10}$ NaOH.
0·22		7·2
0·27		8·1
0·31		8·5
0·36		8·9
0·40		9·2
0·45		9·5

It is considered that best results are obtained when the $\frac{N}{10}$ NaOH readings lie between 6·5 and 9·5. A preliminary titration will indicate what quantities of the lævulose mixture are necessary to give readings between these limits.

Examples:

A Sample of cane-syrup containing 46·0 per cent. invert sugar.
B ,, honey ,, 75·9 ,, ,, ,,

Mixture.	Grms. of Mixture.	C.c. $\frac{1}{10}$ Molecule H_3BO_3.	C.c. $\frac{N}{10}$ NaOH for Blank.	C.c. $\frac{N}{10}$ NaOH corrected for Blank.	Per Cent. Lævulose.
A	1·2	10·0	0·4	8·2	23·3
,,	2·0	,,	0·6	9·5	22·5
B	0·6	,,	0·1	7·3	38·4
,,	0·9	,,	0·2	8·9	40·0

The percentage error in these estimations is of the order of 10 per cent., and is mainly due to the difficulty in determining the end-point.

MAYPOLE LABORATORY,
SOUTHALL.

ABSTRACTS OF PAPERS PUBLISHED IN OTHER JOURNALS.

FOOD AND DRUGS ANALYSIS.

Reaction of Benzoic Acid and its Application to the Detection of Atropine, Cocaine, and Stovaine. M. Guerbet. (*J. Pharm. Chim.*, 1920, **22,** 321-323.)—The reaction described depends on the conversion of the benzoic acid into a mixture of nitrobenzoic acids, reduction of these to aminobenzoic acids which are then diazotised, and the resulting diazonium compounds condensed with β-naphthol. The mixture of *o*-, *m*-, and *p*-naphthol azobenzoic acids formed has an orange-red colour. The test may be used for the detection of atropine, cocaine, and stovaine, or other substances containing a benzoyl group in their molecule. The details of the test are as follows: About 10 mgrms. of benzoic acid are mixed on a watch-glass with 5 drops of fuming nitric acid, and evaporated on a water-bath; the residue is treated with 1 drop of 10 per cent. stannous chloride solution, heated for three minutes, cooled, and 2 drops of 1 per cent. sodium nitrite solution are added. After a few minutes, 4 drops of a 1 per cent. β-naphthol solution in 10 per cent. ammonia are added, when a red orange-coloured precipitate is formed. If this final mixture is evaporated to dryness, the residue dissolved in concentrated sulphuric acid giving a red-violet solution which changes to yellow when the solution is poured into water. W. P. S.

Estimation of Small Quantities of Dextrose. Perrier. (*J. Pharm. Chim.*, 1920, **22,** 337-344.)—An iodimetric method is proposed for the purpose. Twenty c.c. of the sugar solution, containing a few mgrms. of reducing sugar, are treated with 1 c.c. of a 1·5 per cent. solution of crystallised sodium carbonate and 20 c.c. of $\frac{N}{100}$ iodine solution; after two hours the mixture is acidified with hydrochloric acid, and the excess of iodine is titrated with $\frac{N}{100}$ thiosulphate solution. From the quantity of odine solution used 0·1 c.c. is deducted, and the remainder calculated into reducing sugar; the reaction proceeds according to the equation,

$$R.CHO + I_2 + H_2O = 2HI + R.COOH.$$

W. P. S.

Action of Hydrogen Peroxide on Flours. Marion. (*Comptes rend.*, 1920, **171,** 804-806.)—The purity and quality of flour may be estimated by determining the action of its catalase upon hydrogen peroxide, the liberated oxygen being measured in a Niven ureometer. Four c.c. of 8 per cent. hydrogen peroxide, the acidity and oxygen content of which have been accurately estimated, are placed in the side tube of the nitrometer, into the main tube of which is introduced a thin paste of 2 grms. of the flour and 13 c.c. of water, rendered neutral with dilute sodium borate solution, which will add a volume of oxygen equal to 1·8 c.c. to the total liquid. The apparatus is immersed in water at 15° C., and inclined to bring the hydrogen peroxide into contact with the flour. The oxygen liberated in five minutes is collected

in a measuring tube attached to the apparatus, and is measured, after levelling, in the usual way. The following results were obtained with three grades of flour: No. 1, 1·75 c.c.; No. 2, 10·85 c.c.; No. 3, over 20 c.c. per grm. The amounts of cellulose separated from the same flours were 0·22, 0·76, and 6·40 per cent. respectively. Mixtures of 75 per cent. of No. 1 and 25 per cent. of No. 2 gave 5·95 c.c., and 25 per cent. of No. 1 with 75 per cent. of No. 2 gave 10·25 c.c. per grm. C. A. M.

Estimation of Water in Fats and Oils. H. Oertel. (*Chem. Zeit.*, 1920, **44**, 854.)—On mixing in a porcelain dish 10 c.c. of the oil with a known quantity of a substance which evolves heat when moistened, such as a mixture of two parts anhydrous magnesium sulphate with one part kieselguhr, the temperature rise is observed by means of a thermometer graduated in tenths of a degree. The water content is read off from a table. Results by an independent observer agreed with the theory from 0 to 2·5 per cent. water, and showed 3·1 instead of 3 per cent.

O. E. M.

BACTERIOLOGICAL, PHYSIOLOGICAL, ETC.

Estimation of Calcium in Blood-Serum. B. Kramer and J. Howland. (*J. Biol. Chem.*, 1920, **43**, 35.)—One or 2 c.c. of plasma or serum is transferred to a platinum dish, evaporated on a water-bath, dried at 110° C., and gently ignited until completely incinerated. The ash is dissolved in $\frac{N}{1}$ hydrochloric acid and again evaporated and ignited, the residue being dissolved in 1 c.c. of $\frac{N}{10}$ sulphuric acid and transferred to a graduated test-tube. One drop of $\frac{N}{100}$ potassium permanganate solution is run in, when the pink colour should persist for at least one minute, after which 1 drop of 0·01 per cent. phenolsulphonephthaleïn and 1 drop of concentrated ammonia solution are added. The tube is heated on a water-bath to remove excess of ammonia, and while hot exactly 0·3 c.c. of $\frac{N}{10}$ oxalic acid in $\frac{N}{20}$ sulphuric acid is run in. If the solution is not acid in reaction at this point, $\frac{N}{10}$ sulphuric acid is added until the colour is lemon yellow. After heating for a few minutes the tube is cooled, 0·1 c.c. of saturated sodium acetate solution added, the contents well shaken, diluted to 2 c.c., and left to stand several hours. The mixture is filtered, and to 1 c.c. of the filtrate an equal volume of 20 per cent. sulphuric acid is added; the solution is then heated and titrated in daylight with $\frac{N}{100}$ potassium permanganate until a pink colour persists for thirty seconds. The results obtained are subject to a maximum error of 3 per cent. T. J. W.

Estimation of Chlorides in Blood. V. C. Myers and J. J. Short. (*J. Biol. Chem.*, 1920, **44**, 47.)—Three c.c. of blood or plasma are added to 27 c.c. of distilled water in a centrifuge tube, about 0·5 grm. of dry picric acid is added, the mixture stirred until of a bright yellow colour, then centrifuged at a moderate speed for a few minutes, and the clear supernatant liquid decanted. Twenty c.c. are pipetted into a second centrifuge tube, and 20 c.c. of 0·2904 per cent. silver nitrate solution, followed by 10 c.c. of acid ferric alum indicator, added. The precipitate is thrown down by centrifuging, and 20 c.c. portions of the supernatant liquid are removed and

titrated with standard ammonium thiocyanate, 2 c.c. of which is equivalent to 1 c.c. of the silver nitrate. By slightly modifying these conditions the same clear liquid from the picric acid precipitation may be used for the estimation of sugar, creatinine, and chloride. When using pure solutions, and also with known amounts of sodium chloride added to blood, the error due to the above method is less than 1 per cent., and the results agree closely with those given by the Austin–Van Slyke method (ANALYST, 1920, **45**, 226). T. J. W.

Estimation of Iodine in Blood and Animal Tissues. E. C. Kendall and F. S. Richardson. (*J. Biol. Chem.*, 1920, **43**, 149 and 161.)—One hundred c.c. of blood or 100 grms. of solid tissue are placed in a nickel crucible, 10 c.c. of 30 per cent. sodium hydroxide solution added, and the crucible placed upon a hot plate until all water has evaporated. The mass is evenly heated over a Meker burner, and the gas supply adjusted so that all fumes cease to be evolved in less than twelve minutes, the cover being placed on as soon as frothing begins to subside. After cooling about 25 c.c. of water are added, the charred residue scraped from the side of the crucible, ground with a pestle, and boiled with the addition of a further 25 c.c. of water. After filtration the residue is again extracted with hot water containing a little sulphuric acid, and the filtrates mixed, after which 18 grms. of barium hydroxide are added, the solution filtered, sufficient sulphuric acid added to precipitate all barium, and filtration repeated through a pad of kaolin. The filtrate is boiled down to 15 or 20 c.c., transferred to a nickel crucible, and evaporated to dryness. The residue is fused, and from 5 to 10 mgrms. of potassium nitrate added, this being repeated until bubbles of gas cease to be produced on further addition. The cold melt is dissolved in 150 c.c. of hot water, and 5 c.c. of 20 per cent. sodium bisulphite solution and 2 drops of saturated aqueous methyl orange are added. When cold, 85 per cent. phosphoric acid is run in with shaking until the solution just becomes pink, when 5 c.c. of 20 per cent. phosphoric acid are added, and the solution boiled down to a volume of about 200 c.c. On cooling, bromine is added until the solution is yellow, and the solution again boiled for a period of five minutes after it becomes colourless, a few crystals of salicylic acid are dropped in, the solution cooled, and 5 c.c. of 20 per cent. phosphoric acid and 1 grm. of potassium iodide added, when the iodine liberated is titrated with $\frac{N}{200}$ sodium thiosulphate solution, using starch as indicator. Frequent controls should be made on all the solutions used. The method gives good results with solutions containing known amounts of iodine, but with blood the results show a loss of approximately 2·6 per cent. of the total iodine present. T. J. W.

Colorimetric Methods for Estimation of Phosphorus in Urine and Blood. R. D. Bell and E. A. Doisy. (*J. Biol. Chem.*, 1920, **44**, 55.)—*Inorganic Phosphorus.*—One to 5 c.c. of urine are measured into a 100 c.c. graduated flask, and 25 c.c. of water added. To a similar flask are added 5 c.c. of standard monopotassium phosphate solution (1 c.c. of which contains 0·1 mgrm. of phosphorus) and 25 c.c. of water. Five c.c. of molybdic acid solution containing 50 grms. of ammonium molybdate in 1,000 c.c. of $\frac{N}{1}$ sulphuric acid are added to each flask, followed

by 5 c.c. of a solution containing 20 grms. of hydroquinone and 1 c.c. of sulphuric acid per litre. After standing five minutes, 25 c.c. of a solution containing 16 per cent. of sodium carbonate and 3 per cent. of sodium sulphite are run in, the mixtures diluted to 100 c.c., well mixed, and left to stand from five to ten minutes. The colours of the solutions are compared in a colorimeter, and the amount of phosphate deduced.

Total Phosphorus.—One c.c. of urine, 6 or 8 drops of sulphuric acid, and 1 c.c. of nitric acid are placed in a hard glass tube, and cautiously heated until colourless and until nitrous fumes are no longer evolved. The residue is transferred to a 100 c.c. graduated flask with about 25 c.c. of water, and the estimation proceeded with as described above.

Organic Phosphorus.—Twenty c.c. of urine are run into a graduated 25 c.c. flask, made just alkaline with powdered barium hydroxide, diluted to 25 c.c., and filtered. Twenty c.c. of this filtrate are made faintly acid with dilute sulphuric acid, diluted to 25 c.c., filtered, and 10 c.c. of the filtrate (equivalent to 6·4 c.c. of urine) evaporated with sulphuric and nitric acids, the subsequent procedure being as described under total phosphorus.

The results obtained by these methods are slightly lower than those yielded by the uranium method, but agree well with the usual gravimetric results. For the estimation of phosphorus in blood similar methods are employed, after precipitating with trichloracetic acid, as follows: Five c.c. of blood are mixed with 40 c.c. of distilled water, 5 c.c. of 20 per cent. trichloracetic acid are run in during shaking, the whole diluted to 50 c.c., and filtered after standing ten minutes, 10 c.c. of the filtrate being used for the estimation. T. J. W.

Estimation of Reducing Sugars in Blood, etc. O. Guillaumin. (*J. Pharm. Chim.*, 1920, **22**, 378-390.)—The method of Folin and Wu (ANALYST, 1920, 227), with slight modifications, gives good results in the estimation of sugars in blood, except in the case of certain pathological processes which induce an accumulation of non-reducing sugars, which must be eliminated before applying the test. In the colorimetric comparison the intensity of the coloration increases more rapidly in the scale than the proportion of sugar, and the error thus caused is not negligible. This drawback of the method should be eliminated by making the comparison only under definite conditions corresponding with those under which the actual amounts of sugar have been estimated and recorded in the table. C. A. M.

Toxicological Detection of Poisons containing Bromine. A. Damiens. *Comptes rend.*, 1920, **171**, 1020-1023.)—Bromine is a natural constituent of the lungs, 100 grms. of the latter containing 0·3 mgrm., and the ratio of bromine to chlorine is 0·00140. Examination of the lungs of men killed by poison gas consisting of bromine compounds showed that the bromine content of the lungs was higher than the above-mentioned figure; the largest amount found was 1·9 mgrms. per 100 grms. of lung substances, the bromine-chlorine ratio being 0·00386.

W. P. S.

Estimation of Catalase, Peroxydase, and Etherase in a Drop of Blood. A. Bach and S. Zoubkoff. (*Comptes rend.*, 1920, **171**, 967-969.)—A drop of blood is transferred by means of a 20 c.mm. capillary pipette into a flask containing 20 c.c. of water, and 1 c.c. of the mixture is used for each test. *Catalase:* 7 c.c. of water, 1 c.c. of the diluted blood, and 2 c.c. of neutral 1 per cent. hydrogen peroxide are shaken in a 75 c.c. flask, which is then heated for thirty minutes at 37° C. A control test is made at the same time with 1 c.c. of the dilute blood previously heated to boiling point. After the addition of 3 c.c. of $\frac{N}{1}$ sulphuric acid to each flask, the undecomposed hydrogen peroxide is titrated with $\frac{N}{10}$ potassium permanganate solution. The difference between the two results affords a measure of the catalase in the blood. *Peroxydase:* 7 c.c. of water, 1 c.c. of a 1 per cent. solution of pure guaiacol, 1 c.c. of the diluted blood, and 1 c.c. of 1 per cent. hydrogen peroxide are mixed in a test-tube, and the brownish-red coloration, which reaches its maximum after fifteen minutes, is estimated colorimetrically. As a colour standard a liquid is used, the coloration of which matches that of oxidised guaiacol. This is prepared by heating 5 grms. of egg albumin with 2 grms. of cobaltous chloride and 10 grms. of sodium hydroxide in 250 c.c. of water, and filtering the liquid. This is standardised against solutions containing 0·0005 to 0·001 grm. of guaiacol oxidised by means of an excess of vegetable peroxydase and hydrogen peroxide. The peroxydase is conveniently prepared by macerating 1 kilo of pulped radish with 500 c.c. of water, straining and filtering the extract, precipitating the peroxydase by means of alcohol, and redissolving the precipitate in 500 c.c. of water. With the addition of toluene the solution keeps indefinitely. *Etherase:* A solution of 0·2 grm. of potassium sulphoguaiacolate in 7 c.c. of water is mixed with 1 c.c. of 1 per cent. hydrogen peroxide, 1 c.c. of dilute peroxydase solution (1 : 20), and 1 c.c. of diluted blood (1 : 1,000), and the tube allowed to stand for thirty minutes at the ordinary temperature. The guaiacol liberated by the etherase is oxidised by the peroxydase and hydrogen peroxide, and is estimated colorimetrically in the same way as in the case of peroxydase. A control test is made, as before, with 1 c.c. of the dilute solution of blood previously heated to boiling-point. The examination of forty samples of blood by these methods gave the following results: *Catalase:* hydrogen peroxide decomposed by 1 c.mm. of blood, 17·17 to 18·78 mgrms. *Peroxydase:* 0·096 to 0·153 mgrm. of guaiacol oxidised. *Etherase*: 0·108 to 0·147 mgrm. of guaiacol liberated and oxidised. C. A. M.

Formation of Gum Levan by Mould Spores. N. and L. Kopeloff and C. J. Welcome. (*J. Biol. Chem.*, 1920, **43**, 171.)—The spores of *Aspergillus sydowi* are thoroughly washed with sterile water, transferred to a sterile flask with 10 per cent. of chloroform, and heated at 62·5° C. for one hour. The suspension is thoroughly ground with sand, added to 500 c.c. portions of 10 per cent. sugar solution, and incubated at 40° C. for ten days. The clear solution is siphoned off, made slightly alkaline with sodium hydroxide, and the gum precipitated by the addition of five volumes of 95 per cent. ethyl alcohol. The precipitated gum is washed with alcohol, dissolved in water, and reprecipitated several times by alcohol, when it is dried on filter-paper, and finally on unglazed porcelain at 20° C. for eighteen hours. The

product is soluble to an opalescent solution in water, contains 0·16 per cent. of ash, gives a specific rotation of −40° in 0·25 per cent. solution, and on hydrolysis with concentrated hydrochloric acid the change in rotation produced indicates quantitative hydrolysis into levulose. Since the presence of levan in sugar solution renders the Clerget method of estimation inaccurate, the percentage of sugar present must be determined by the use of invertase, and Hudson's method (ANALYST, 1914, **39**, 443) for the preparation of a solution of this enzyme possessing high activity is described. By a combination of the invertase method and the Clerget hydrolysis the amount of gum levan present in a sugar solution may be determined. A table is provided showing the reactions given by a number of reagents when added to an aqueous solution of levan. T. J. W.

Reaction of Milk in Relation to the Presence of Blood-Cells and of Specific Bacterial Infections of the Udder. J. C. Baker and R. S. Breed. (*J. Biol. Chem.*, 1920, **43**, 221.)—The authors examined the sensitiveness of bromcresol purple, bromthymol blue, phenol red, rosolic acid, and Hoyberg's reagent to the acidity of milk in comparison with the P_H value determined electrometrically, and found the first-named indicator to give a more satisfactory series of changes of tint, especially with normal milk, than was shown by the other indicators. One hundred and twenty-four samples of milk from cows in three herds were examined, and the reaction, leucocyte and epithelial cell content, and the presence, both before and after incubation, of streptococci determined. From the results of this work the deduction is drawn that the number of leucocytes, epithelial cells, and streptococci present is roughly inversely proportional to the acidity of the milk, the primary cause of the abnormalities being in the majority of cases an infection with streptococci. The physiology of the results is discussed, and it appears probable that the decrease in acidity is due to the entrance of sodium bicarbonate from the blood.
T. J. W.

Estimation of Urea in Sera and Secretions. W. Mestrezat and M. P. Janet. (*J. Pharm. Chim.*, 1920, **22**, 369-377.)—To obtain accurate results in the estimation of urea by the xanthydrol method (ANALYST, 1914, **39**, 268, 362) it is necessary that the serum or other fluid should contain between 0·5 and 1·0 grm. of urea, preferably 0·5 grm., and that twice the amount of xanthydrol solution should be used. Ten c.c. of the serum diluted according to the amount of urea presumed to be present are mixed with 10 c.c. of Tanret's reagent (3·32 grms. of potassium iodide and 1·35 grms. of mercuric chloride in 20 c.c. of acetic acid and 60 c.c. of water) and centrifuged. The clear liquid (15 c.c.) is treated with an equal volume of glacial acetic acid, and then with 3 c.c. of a freshly-prepared 10 per cent. solution of xanthydrol in pure methyl alcohol added in three portions at intervals of ten minutes; the condensation of the xanthyl urea will be complete in three hours, and the crystals are then separated, washed with absolute methyl alcohol, dried in the water-oven, and weighed. C. A. M.

Gravimetric Estimation of Albumin in Urine. G. Pegurier. (*Ann. Chim. anal.*, 1920, **2**, 332-335.)—The urine is neutralised with acetic acid, filtered, and 50 c.c. of the filtrate are heated to boiling and allowed to cool for a few minutes; 5 c.c. of a solution of 10 grms. of phenol and 10 grms. of citric acid in 20 grms. of 95 per cent. alcohol are then added, the precipitated albumin is collected on a weighed filter, washed first with boiling water, then with a mixture of alcohol and ether, dried at 100° C., and weighed. W. P. S.

Estimation of Total Nitrogen in Urine by the Dumas and Kjeldahl Methods. W. Mestrezat and M. P. Janet. (*Comptes rend.*, 1920, **171**, 1019-1021.)—Comparative estimations of total nitrogen in urine showed that the Kjeldahl method always gave lower results than those found by the Dumas method, the deficiency varying from 0·09 to 0·42 grm. of nitrogen per litre of urine.

W. P. S.

Quantitative Method for the Determination of Vitamine in Connection with Determinations of Vitamine in Glandular and Other Tissues. F. K. Swoboda. (*J. Biol. Chem.*, 1920, **44**, 531-551.)—The work of Williams (ANALYST, 1920, **45**, 307) demonstrates that a substance of unknown structure, a constituent of yeast, is necessary in addition to the ordinary nutrients for the nutrition of yeast cells. This substance, Williams concludes, based upon identical occurrence and various properties, is identical with the beri-beri preventing vitamine. He further found that the growth of single cells of yeast may be used as a simple biological test for this vitamine. The work here presented shows that this vitamine, or, as McCollum calls it, the water-soluble B growth-promoting substance, can be quantitatively determined by a simple biological method, and from the experiments cited it is clear that the yeast cells, when grown on a synthetic medium containing sugar, asparagine, ammonium nitrogen, potassium, calcium, magnesium, sulphate, and phosphate, are dependent for their growth on a substance soluble in 95 per cent. alcohol and water, but of unknown chemical structure. This substance stimulates the growth of the yeast cell, or the multiplication of the cell, so that a unit weight of this substance is essential for the growth of a definite number of yeast cells (*cf. La Cellule*, 1901, **18**, 313). This fact is made the basis of the present method for the quantitative determination of this substance, which in all probability is identical with the beri-beri curative vitamine. The biological test of Williams for the detection of small quantities of the water-soluble B vitamine was developed, and found to be of quantitative value. The method was applied, and the vitamine content of various organs determined. A summary of all determinations, giving the different vitamine numbers, is given. From the results of these determinations it is evident that this specific vitamine is present in large quantities in most of the organs of internal secretion which are of developmental importance, whereas it usually is present in very much lower concentrations in other organs examined. The liver and kidneys, however, are high in vitamine content. The tissues high in nuclear material, such as thymus and lymph gland, were found low in vitamine content. The fresh pancreas was found low in activity. It is suggested that high

content reported by others may be due to hydrolysis. The thyroid was the only organ in which an increase in concentration of the vitamine fraction caused a toxic action. Without proper dilution the vitamine activity would not be observed. These vitamine determinations afford additional evidence that the substance which increases the multiplication of the yeast cell is identical with the beri-beri curative vitamine. H. F. E. H.

ORGANIC ANALYSIS.

Titrimetric Determination of Minute Amounts of Acetone. R. S. Hubbard. (*J. Biol. Chem.*, 1920, **43**, 43.)—The method adopted by the author is a modification of the one originally used by Messinger. Stock solutions of iodine in potassium iodide and of sodium thiosulphate are prepared, 1 c.c. of each being equivalent to 1 mgrm. of acetone. Water free from ammonia and other volatile matters is used for diluting these solutions to $\frac{1}{10}$, $\frac{1}{50}$, or $\frac{1}{100}$ of their original strength, and additional potassium iodide is added to the dilute iodine solutions to make the concentration of this salt approximately 3 per cent. These dilute solutions do not remain constant in strength for more than two days. To 50 or 100 c.c. of the acetone solution a known amount of iodine solution is added, the quantity and strength used depending upon the amount of acetone expected to exist in the solution, but in any case excess of iodine must be used. To the mixed solutions 2 c.c. of sodium hydroxide solution (200 grms. sodium hydroxide in 300 c.c. of water) are added, the mixture shaken, and allowed to stand ten minutes or longer, when 1 or 2 c.c. of 60 per cent. sulphuric acid is added, and the solution titrated with $\frac{N}{1000}$ or other known strength of sodium thiosulphate, using starch solution as indicator. Since the solutions to be estimated may contain substances, such as alcohol, liable to vitiate the results obtained by the above method, the author has worked out methods depending upon oxidation by sodium peroxide, sulphuric acid, and potassium permanganate or potassium dichromate, which destroy these substances, while the acetone present is unaffected. The results obtained by the above method are in good agreement with the actual amount of acetone present in aqueous solution. T. J. W.

Estimation of Acetone in Expired Air. R. S. Hubbard. (*J. Biol. Chem.*, 1920, **43**, 57.)—The subject, fitted with a mask provided with an inlet valve for inhaled air, expired for ten minutes through two bottles arranged in series, each containing 75 c.c. of fresh 2·5 per cent. sodium bisulphite solution. Ten c.c. of 10 per cent. sodium hydroxide were added to each bottle, and the contents of each separately were washed into a Kjeldahl flask. The solution was distilled for ten minutes into a second Kjeldahl flask containing water to give a final volume of about 150 c.c. To the distillate 5 c.c. of 60 per cent. sulphuric acid and 0·2 grm. of potassium permanganate were added, and the solution again distilled to give about 100 c.c. of distillate. To this distillate 0·5 grm. of sodium peroxide were added, and the mixture distilled into a little water to give a volume of from 50 to 100 c.c. The acetone present in this final distillate was determined by the method given in the

preceding abstract or by the turbidimetric method, using the Scott-Wilson reagent (mercuric cyanide 10 grms., sodium hydroxide 180 grms., water 1,200 c.c.; the solution is shaken, and 400 c.c. of 0·7268 per cent. silver nitrate solution slowly run in, after which the solution should be kept at least one day before use). Quantitative determinations made by the above method show excellent agreement with the known amounts of acetone used. Normal adults exhale from 0·14 to 0·91 mgrm. of acetone per hour, but in cases of diabetes and exophthalmic goitre the amount increases to 5·24 and 15·0 mgrms. respectively. T. J. W.

Analysis of Aromatic Nitro Compounds by Means of Titanium Trichloride. F. L. English. (*J. Ind. and Eng. Chem.*, 1920, **12**, 994-997.)—Mononitro hydrocarbons are very resistant towards reduction by titanium trichloride, but the presence of positive or negative substituents, with the exception of chlorine, in the nucleus facilitates the reduction of the nitro group. Further, it would appear from the results of experiments carried out by the author that the position of the substituents with respect to the nitro group has no appreciable effect; for instance, *m*- and *p*-nitroaniline are reduced with equal ease, as are *o*- and *p*-nitrophenols, *o*- and *m*-nitro-*p*-toluidines, and two of the nitrosalicylic acid esters, whilst *o*- and *p*-nitrochlorobenzenes are about equally refractory. The essential point in the reduction is the excess of titanium trichloride used; the final concentration, after the mixture has been boiled, should be not less than 25 c.c. of $\frac{N}{20}$ titanium trichloride solution per 100 c.c. of total solution. W. P. S.

Viscosity of Cellulose Ester Solutions. M. Deschiens. (*Chem. Trade J. and Chem. Engineer*, 1920, **67**, 472.)—The determination of the viscosity of cellulose nitrate and acetate is of great importance, and the usual processes for measuring this property are unsuitable, because the evaporation of the solvent at the orifice of the viscosimeter leaves a film which blocks up the opening. The viscosimeter recommended is that of Ostwald, and is of a **U**-shaped pattern with the usual two bulbs, the base of the **U**, however, having right-angle bends. The standard for comparison adopted by the Allied Aviation Services is the viscosity of glycerol of 30° Baumé, at 15° C., the value of which is fixed at 100. The instrument is calibrated by means of glycerol under these conditions while almost entirely immersed in a thermostat at 15° C. If cellulose acetate is the ester under examination, the solution should be composed of 6 grms. of this material (preferably dried at 100° to 105° C.) and 100 grms. of acetone, great care being taken to see that solution is complete before use; if necessary, it may be centrifuged or filtered. Working with a solution of this strength, it was found that the time of flow was thirty seconds as against 190 for glycerol, and as this 190 is taken as being the 100 standard, the viscosity of the sample $(x) = \frac{190}{100} = \frac{30}{x}$, where $x = 15{\cdot}79$. Cellulose acetates of different origins, when dissolved in acetone, show figures varying from 42 to 10·5, and if intended for manufacture of aeroplane dopes, should lie between 10 and 30. Samples showing higher viscosity are preferable for the manufacture of plastic masses or celluloid. H. F. E. H.

Analysis of Fabrics composed of a Mixture of Cotton and Wool. Duyk. (*Ann. Chim. anal.*, 1920, **2**, 324-330.)—The following standard method has been proposed: From 10 to 15 grms. of the sample are dried at 100° C. and re-weighed. The dry material is then treated with suitable reagents for the removal of dressing, filling, etc., washed, dried, and again weighed. The material, after this preliminary treatment, is heated at 90° C. for twenty minutes with 2 per cent. sodium hydroxide solution, then washed first with water, next with acidified water, again with water, dried at 100° C., and weighed. The loss in weight corresponds with the amount of wool present, and the proportions of cotton and wool are calculated on the original substance. If silk is also present in the fabric, the latter is treated with zinc chloride solution (sp. gr. 1·65) before the cotton and wool are separated as described; the zinc chloride dissolves the silk, but leaves the cotton and wool unaffected. W. P. S.

Chia Oil. H. A. Gardner. (*Chem. Trade J.*, 1920, **67**, 674-675.)—The seeds of the Mexican plant, chia, yield a yellow oil resembling linseed oil in odour and taste. A sample of the seeds contained 33·83 per cent., of oil. The filtered oil had the following values: Sp. gr. at 15·5° C., 0·9338; $[n]_{D\ 25°\ C.} = 1·4855$; acid value, 0·6; saponification value, 192·2; iodine value, 196·3; and unsaponifiable matter, 0·8 per cent. In the raw state the oil dried somewhat slowly, and showed pronounced "crawling"—*i.e.*, tendency to coalesce in drops at points, leaving the previously coated surface bare. This was prevented by heating the oil for fifteen minutes at 500° F., and in this condition the oil was superior to linseed oil as a drying oil. The oil-cake contained: Oil, 10·5; nitrogen, 3·6; and phosphoric anhydride, 1·5 per cent. C. A. M.

Jelly Strength of Gelatins and Glues. S. E. Sheppard, S. S. Sweet, and J. W. Scott, jun. (*J. Ind. and Eng. Chem.*, 1920, **12**, 1007-1011.)—A torsion dynamometer is described for determining the jelly strength of gelatin and glue under pure shear of moulded cylindrical test pieces. Both the breaking load and percentage twist at break are measured; the product of breaking load × twist, divided by the cross section of the test piece, is taken as the jelly strength. There is no simple relation between concentration of gelatin and the jelly strength; hence, the jelly strength values determined for a single arbitrary concentration give a very arbitrary comparison of the jelly strengths. There appears, therefore, to be no definite relationship between the jelly strength at a given concentration and the glue-joint or tensile strength of a dry glue joint. W. P. S.

Determination of Sulphur Monochloride in Mustard Gas Mixtures. W. A. Felsing, S. B. Arenson, and F. J. Kopp. (*J. Ind. and Eng. Chem.*, 1920, **12**, 1054.)—Twenty-five c.c. of approximately $\frac{N}{1}$ sodium iodide solution and 10 c.c. of carbon tetrachloride are run into a stoppered flask, which is then accurately weighed. By means of a pipette 2 c.c. of the mustard gas-sulphur chloride mixture is added rapidly, and the flask again weighed. A known excess of standard sodium thiosulphate solution is run in, and the excess titrated with standard iodine solution,

using starch as the indicator. The number of c.c. of sodium thiosulphate used multiplied by its equivalent of sulphur monochloride ($S_2Cl_2 = I_2$) gives the content of the latter substance in the sample. The accuracy of the method is within 0.5 per cent. in concentrations of 20 to 30 per cent. of sulphur monochloride, and within 0·1 per cent. for small proportions. The method is reliable for concentrations as low as 0·04 per cent. of sulphur monochloride. T. J. W.

INORGANIC ANALYSIS.

Analysis of Light Aluminium Casting Alloys. R. M. Berry. (*J. Ind. and Eng. Chem.*, 1920, **12**, 998-1000.)—One grm. of the alloy is treated with 20 c.c. of 25 per cent. sodium hydroxide solution, and the mixture diluted to 300 c.c. as soon as effervescence ceases; this is necessary to prevent tin passing into solution. The insoluble portion, containing the tin, copper, lead, iron, nickel, part of the manganese, and traces of aluminium, is collected on a filter, and washed ten times with 1 per cent. sodium hydroxide solution. The filtrate contains 99 per cent. of the aluminium and zinc and the remainder of the manganese; it is neutralised with formic acid, 25 c.c. of the acid are added in excess, the mixture heated to boiling, and treated with hydrogen sulphide. The zinc sulphide is collected, washed with hot water, dissolved in hydrochloric acid, the solution boiled to expel hydrogen sulphide, and the zinc then titrated with potassium ferrocyanide solution. *Tin.*—The portion of the sample insoluble in sodium hydroxide solution is heated with 10 c.c. of nitric acid, the mixture then diluted with 30 c.c. of hot water, the metastannic acid collected, washed with hot water, dissolved in ammonium sulphide solution (to separate silica, traces of iron, lead, etc.), the solution filtered, and the tin sulphide reprecipitated from the filtrate, collected, ignited to SnO_2, and weighed. *Copper and Lead.*—The filtrate from the metastannic acid is diluted to 150 c.c., and the copper and lead are deposited electrolytically, using a current of 1 ampere and 2·5 volts; about forty-five minutes are required for the deposition of the lead. Two c.c. of dilute sulphuric acid (1 : 1) are then added, and the electrolysis continued for a short time. The electrodes are at once removed from the solution, washed twice with water and once with alcohol, and dried, the cathode at 80° C. for fifteen minutes and the anode at 210° C. for thirty minutes. The increase in weight of the cathode gives the copper, whilst the increase in weight of the anode is the PbO_2. *Iron.*—The electrolyte from the copper and lead estimation is treated with 3 grms. of ammonium chloride, rendered ammoniacal, boiled, and the ferric hydroxide (with a trace of aluminium hydroxide) is collected, redissolved in dilute hydrochloric acid, and the iron titrated with permanganate solution after reduction with stannous chloride. *Nickel.*—The filtrate from the iron is rendered just acid with hydrochloric acid, boiled, dimethylglyoxime is added, the mixture then rendered very slightly ammoniacal, and, after one hour, the precipitate is collected, washed with hot water, then with alcohol, dried at 110° C., and weighed. The weight multiplied by 0·2031 gives the amount of nickel present. *Magnesium.*—This is estimated by the phosphate method in the filtrate from the glyoxime precipitate. *Manganese.*—One grm. of the alloy is treated with 25 per cent. sodium hydroxide solution, an excess of nitric acid

is then added, together with a few crystals of silver nitrate, the mixture is boiled, oxidised with persulphate, cooled, and the permanganate formed titrated with arsenite solution. *Silicon.*—One grm. of the alloy is dissolved in a mixture of nitric and sulphuric acids, a few drops of hydrochloric acid are added, the solution is evaporated to dryness, the residue taken up with hydrochloric acid and water, and the silica collected, ignited, and weighed. The ignited silica should be treated in the usual way with hydrofluoric acid. W. P. S.

Analysis of Aluminium, Cobalt, and Chromium Alloys. J. R. Camp and J. W. Marden. (*J. Ind. and Eng. Chem.*, 1920, **12**, 998.)—A suitable quantity of the alloy is heated with a small quantity of *aqua regia*, and the solution then evaporated with the addition of 3 c.c. of sulphuric acid, and heated until sulphuric acid fumes appear. After cooling, the solution is diluted to 100 c.c., transferred to a pressure bottle, saturated with hydrogen sulphide, the bottle then closed, heated in a boiling water-bath for one hour, allowed to cool, and the molybdenum sulphide collected and washed. The filtrate is again saturated with hydrogen sulphide to make certain that all the molybdenum has been precipitated. It is advisable to redissolve the precipitate and repeat the precipitation. The molybdenum sulphide is finally ignited at a dull red-heat in a muffle furnace for two hours and weighed as MoO_3. The filtrate from the molybdenum sulphide is boiled to expel hydrogen sulphide, sodium peroxide is added, the mixture boiled, and the precipitated cobalt hydroxide collected, dissolved in dilute hydrochloric acid, again precipitated with peroxide, collected, ignited, and weighed as Co_3O_4. The filtrate from the cobalt is acidified with sulphuric acid, boiled to decompose peroxide, and the chromate in solution then titrated with ferrous ammonium sulphate solution. A sample of the alloy analysed by the authors yielded molybdenum, 41·52; cobalt, 50·89; and chromium, 7·56 per cent. The alloy known under the name of "Stellite" has a similar composition; it is extremely hard, and is used for making cutting tools.

W. P. S.

Estimation of Traces of Bromine in Organic Substances. A. Damiens. (*Comptes rend.*, 1920, **171**, 799-802.)—The organic material is dried at 100° to 105° C., with the previous addition of a small amount of potassium hydroxide in toxicological work, the dry substance pulverised with 5 parts of potassium nitrate and 10 parts of sodium carbonate, and the mixture heated in a silver crucible in a muffle furnace, but without allowing the mass to fuse. It is then treated with water, the solution filtered after twenty-four hours, and the filtrate divided into two portions. Iodine is estimated in one of these by treating the acidified liquid with an excess of silver nitrate, and leaving it for twenty-four hours in the dark. The precipitate is then washed, suspended in 10 c.c. of water, and a current of chlorine introduced for fifteen minutes in the cold, after which 1 c.c. of sulphuric acid is added, and the current of chlorine continued for five minutes at 100° C. Finally, the chlorine is expelled by a current of air, the liquid centrifuged, and the separated solution treated with a few drops of sulphur dioxide solution, 2 c.c. of chloroform, and an excess of 5 per cent. sodium nitrite solution. If iodine be found, it is estimated colorimetrically

in the chloroform or (if more than 0·5 mgrm. is present) by a volumetric method, after complete extraction of the liquid with chloroform. The second portion of the original aqueous solution is neutralised, acidified with nitric acid (1 c.c. excess), treated with excess of $\frac{N}{10}$ silver nitrate solution, boiled for ten minutes, and placed for three hours on the water-bath. The precipitate is separated the following day, washed, and reduced by mixing it with 3 to 4 c.c. of water, 3 drops of sulphuric acid, and a fragment of zinc. If less than 1 mgrm. of iodine was found the solution is filtered, reduced, the silver washed, and the washings added to the solution in which the bromine is estimated by the method of Denigès and Chelle (ANALYST, 1913, **38**, 119). If more than 1 mgrm. of iodine be present, the filtrate and washings are neutralised with ammonia, diluted to 40 c.c., and distilled with 1 grm. of ferrous ammonium sulphate, so as to leave a residue of 10 c.c., in which the bromine is then estimated. By this modification of the method 0·005 mgrm. of bromine can be estimated. C. A. M.

Catalytic Decomposition of Alkaline Sodium Hypobromite Solution by Copper Sulphate. P. Fleury. (*Comptes rend.*, 1920, **171**, 957-960.)—In view of the fact that salts of nickel, cobalt, and copper decompose hypochlorites and hypobromites with the liberation of oxygen, and that copper is sometimes present as an impurity in sodium hydroxide, the ordinary method of estimating urea by means of alkaline sodium hypobromite solution may give erroneous results. This catalytic action of copper may be entirely inhibited by the action of iodine, whether present in the form of iodide or iodate. Hence it is advisable, when a solution of hypobromite is required for the estimation of small quantities of urea, to add about 0·1 per cent. of potassium iodide to solution (*a*) of the following reagent: (*a*) Sodium hydroxide solution, 55 c.c. diluted to 100 c.c. with water. (*b*) Bromine, 8·5 c.c.; potassium bromide, 50 grms.; water, 80 to 82 c.c. Equal parts of the two solutions are mixed just before use. C. A. M.

Estimation of Copper in Sugar Analysis by Means of Potassium Thiocyanate and Potassium Iodide. G. Bruhns. (*Zeitsch. anal. Chem.*, 1920, **59**, 337-359.)—The following procedure is recommended for the iodimetric estimation of copper, since it effects a considerable saving in the quantity of potassium iodide required: Twenty c.c. of Fehling's solution and 20 c.c. of the sugar solution are mixed, heated to boiling, boiled for exactly two minutes, and cooled rapidly. Five c.c. of potassium thiocyanate iodide solution (containing 0·65 grm. of potassium thiocyanate and 0·1 grm., of potassium iodide) are added, followed by 10 c.c. of 6·5 N sulphuric acid, and the mixture is at once titrated with thiosulphate solution (34·4 grms. per litre). A control titration is made at the same time, using the same quantities of reagents, but omitting the heating, and the difference between the quantities of thiosulphate solution required for the two titrations in a measure of the sugar present. Tables are given showing the quantities of invert sugar corresponding with quantities of thiosulphate solution varying from 0·8 to 19·6 c.c. in differences of 0·1 c.c. W. P. S.

Volumetric Estimation of Hydrosulphite. R. Formhals. (*Chem. Zeit.*, 1920, **44**, 869.)—The hydrosulphite, 0·5 grm., is dissolved in about 50 c.c. of boiled water, and titrated with $\frac{N}{10}$ potassium ferricyanide solution until the indicator, a few drops of 10 per cent. ferrous ammonium sulphate solution, gives a blue coloration. The sulphurous acid is without effect in the cold. The standard solution is best adjusted against pure hydrosulphite. O. E. M.

Microchemical Reactions of Iodic Acid. A. Bolland. (*Comptes rend.*, 1920, **171**, 955-957.)—*Thallium nitrate* at first produces crystalline needles which appear colourless to the naked eye, but black under the microscope. In the second phase the crystals unite in groups of crosses with straight arms. They have an average size of 40 μ. The reaction is capable of detecting 1 part of iodic acid in 5,000. *Silver nitrate* gives an amorphous product, which crystallises from ammonia solution in rhombic plates (up to 100 μ), united in groups of four or six. Sensitiveness of test, 1 : 5,000. *Barium chloride* gives a precipitate of straight or curved needles (up to 300 μ) grouped in twos or fours. Sensitiveness, 1 : 2,500. *Strontium acetate* forms needles and fine prisms (100 μ) grouped together, frequently in the form of a cross. Sensitiveness, 1 : 300. *Calcium acetate* forms colourless monoclinic octahedra of mean size 150 μ. Sensitiveness of test, 1 : 300. *Rubidium chloride* produces rectangular plates, which have the appearance of pentagons or hexagons. The crystals (25 μ) show a strong refraction. Sensitiveness of test, 1 : 300. In the case of concentrated solutions of iodic acid, cæsium sulphate, potassium chloride, sodium acetate, ammonia, and magnesium chloride, also form characteristic crystals, the sensitiveness of the tests ranging from 1 : 20 to 1 : 80. C. A. M.

Sensitive Colour Reaction of Phosphates and Arsenates. G. Denigès. (*Comptes rend.*, 1920, **171**, 802-804.)—On treating a very dilute solution of ammonium molybdate with a stannous chloride reagent, a blue coloration due to a basic salt of molybdenum is obtained. This reagent is prepared by heating 0·1 grm. of tin foil with 2 c.c. of hydrochloric acid and 1 drop of 3 per cent. copper sulphate until solution is complete, diluting the liquid to 10 c.c. with water, and decanting it from any deposit. Acidification of the dilute molybdate solution with hydrochloric or sulphuric acid checks, and at a certain limit inhibits, the reduction by stannous chloride, but if at this point a solution of a phosphate is added, a stable blue coloration, due to the formation of a complex molybdic phosphate, is produced. The test is capable of detecting 0·02 mgrm. of phosphorus in the form of phosphate, and can be applied in the presence of organic matter. A complex blue arsenate is formed under the same conditions, and the reaction may be used for the colorimetric estimation of arsenic deposits obtained in Marsh's test. Conversely the reaction may be used for the detection of tin or molybdenum. C. A. M.

Phosphomolybdic and Phosphotungstic Acids. H. Wu. (*J. Biol. Chem.*, 1920, **43**, 189.)—The author discusses the history, modes of formation, chemica properties, and composition of the various phosphomolybdic and phosphotungstic

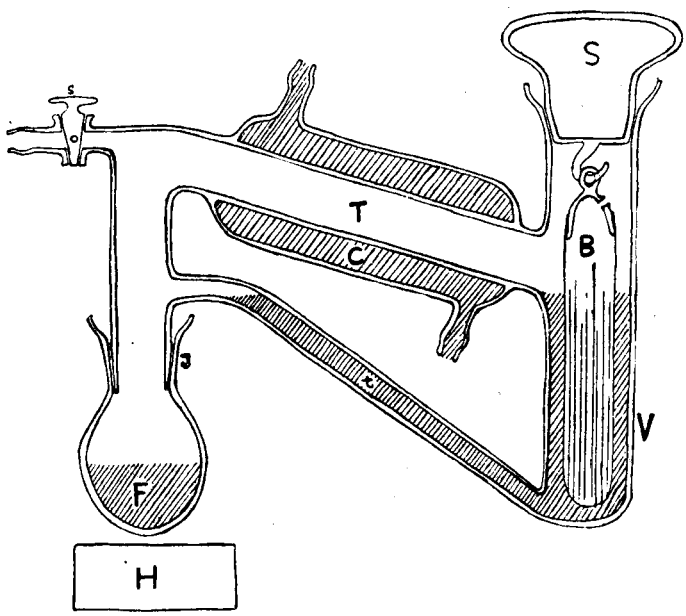
acids, and suggests their application in analytical chemistry. The "mixed acid" solution used is prepared by dissolving 100 grms. of sodium tungstate and 25 grms. of sodium molybdate in 700 c.c. of water, adding 50 c.c. of 85 per cent. phosphoric acid, 100 c.c. of hydrochloric acid, and boiling under a reflux condenser for eight hours.

Detection of copper: To the solution under examination are added a few drops of 5 per cent. potassium cyanide solution, hydrochloric acid in sufficient amount to give an acid reaction, and a few drops of the above "mixed acid" solution. The solution is rendered alkaline by the addition of sodium carbonate, and a blue colour is produced if copper is present even in traces.

Detection of phosphoric acid: 1 or 2 c.c. of 2 per cent. ammonium molybdate, a few c.c. of 10 per cent. potassium iodide, 1 c.c. of 10 per cent. sodium bisulphite solution, and finally 1 to 2 c.c. of hydrochloric acid are added to the solution to be tested, which is then mixed and allowed to stand twenty minutes. On making alkaline by the addition of saturated sodium carbonate, a blue colour indicates the presence of phosphoric acid. This test is sensitive to 1 part of phosphorus in 1,000,000 parts of water, and may also be made the basis of a method for the colorimetric estimation of phosphoric acid. The "mixed acid" solution is also suggested as an indicator in oxidation or reduction titrations. T. J. W.

APPARATUS, ETC.

Apparatus for Continuous Dialysis or Extraction. H. Mann. (*J. Biol. Chem.*, 1920, **44**, 207-209.)—The apparatus consists essentially of a flask, a condenser, and a vessel so arranged that the system may be evacuated, and that liquid



placed in the apparatus may be caused to circulate by means of continuous evaporation and condensation. Substances that will pass into solution are extracted and

concentrated under thermal and chemical conditions favourable for the preservation of labile and easily-decomposed compounds. Fig. 1 is a drawing of the apparatus. The flask, F, is equipped with a ground joint, J, provided with a mercury cup. H is a heating unit suitable for heating the flask, F. An incandescent bulb may be used. *s* is a stop-cock attached to a short tube. T is a condenser tube, and C is the condenser. V is a vessel fitted with a ground stopper, S, provided with a mercury cup. B is a bag of collodion, cloth, or other material suspended in the vessel, V. *t* is a narrow tube, through which fluid in V can flow back into F. The method of operation is as follows: The substance to be extracted or dialysed is placed in the bag, B, which is suspended in the vessel, V. Enough of the desired solvent is introduced into the vessel, V, so that it overflows through the tube, *t*, into the flask, F, partly filling the flask. The apparatus is then exhausted to the desired degree through the tube which is fitted with the stop-cock, *s*, and this stop-cock is then closed. The condenser tube, T, is now cooled by means of a stream of water circulating through the condenser, C, and the flask, F, is warmed by the heating unit, H. There results a continuous evaporation of the fluid in the flask, F, and a continuous condensation of this evaporated fluid in the condenser tube, T. The condensed liquid flows into the vessel, V, causing the level of the fluid in V to rise, so that fluid flows through the small tube, *t*, back into the flask, F. Thus the vessel, V, is continuously receiving a supply of freshly distilled solvent, and discharging its content into the flask, F, in which flask continuous evaporation of the fluid and concentration of non-volatile matter are taking place. The apparatus has the following advantages: A small amount of solvent can be used for the extraction of a large amount of material; this extraction can be made as complete as desired, and the substances extracted are at the same time concentrated. The apparatus, being operated at reduced pressure, is especially suitable for the extraction of labile substances, which are destroyed either by oxidation or by high temperature. With water as the solvent and the apparatus well exhausted, it is not necessary to warm the flask, F, more than 10° to 15° C. above room temperature. By using a collodion bag or other suitable dialysing membrane, it is possible to extract and concentrate the diffusible substances in plant and animal tissues—as, for example, the amino-acids of blood, muscarin, and other thermolabile alkaloids from fungi—and thus to obtain many substances of pharmacological importance.

H. F. E. H.

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REVIEWS.

INDUSTRIAL GASES. By HAROLD CECIL GREENWOOD, O.B.E., D.Sc., F.I.C. Pp. xvii + 371. London: Baillière, Tindall and Cox, 1902. Price 12s. 6d.

This book, forming one of a series on chemical industries, edited by Dr. S. Rideal, is a useful addition to chemical literature. Excepting a good translation of Claude's "Air liquide, Oxygène et Azote," and articles in dictionaries, very little was to be found on this subject in the English language.

One can only regret that the gifted author should have died at the early age of thirty-two, almost on the eve of the publication of his work; the foreword by Dr. J. A. Harker indicates plainly the loss to science and industry occasioned thereby.

The work is divided into an Introduction and three parts dealing respectively with (1) The Gases of the Atmosphere; (2) Hydrogen, Carbon Monoxide, Carbon Dioxide, Sulphur Dioxide, Nitrous Oxide, Asphyxiating Gases; (3) Gaseous Fuels.

The Introduction gives an excellent account of the physics of gases, as well as of the equilibrium of gas reactions.

Part I. deals chiefly with the separation of oxygen, nitrogen, and the rare gases of the atmosphere; there is, in addition, a section on ozone. This part of the book contains, as might be expected, descriptions of liquefying plant; the explanations are clear, and the illustrations well chosen.

More than half of Part II. is devoted to hydrogen, nearly fifty pages being assigned to the industrial preparation of this gas. This division is certainly justifiable in view of the great importance of pure hydrogen in synthesising ammonia, hardening fats, or, in fact, in any process in which hydrogen is brought into combination with the aid of a catalyst.

Part III., dealing with gaseous fuels, only takes up sixty-four pages. The reviewer would have liked to have seen a few woodcuts illustrating the construction of the plant employed, even if these illustrations had been quite diagrammatic in character. It must be admitted, however, that the author succeeded in utilising the sixty-four pages to great advantage, and the exposition of "Fundamental Principles" is excellent.

Both Subject and Authors' Indexes appear to be thorough, and the value of this useful book is enhanced by the lists of references given at the end of many of the sections.

J. T. HEWITT.

SOLUBILITIES OF INORGANIC AND ORGANIC SUBSTANCES. By ATHERTON SEIDELL, Ph.D. Second Edition. Pp. xxii + 843. Price 45s. net.

Even a casual survey of this book arouses in the reader two feelings: one of gratitude to the author for his achievement, the other of thankfulness that the compilation of such stupendous compendia of physical constants is no longer almost exclusively the work of other than English-speaking authors. The publication of books of this type, of the value and, indeed, of the indispensability of which there can be no question, should be the duty of the scientific societies, and one feels, there-

fore, all the more admiration for the individual whose patient, persevering labour has resulted in the production of this book. Twenty-three of the best-known scientific journals from the year 1900 onwards have been searched page by page for solubility data, and the tables of contents of twenty-five other journals have been consulted. The mass of information obtained proved too voluminous to form a supplement to the first edition, so the whole book has been revised and enlarged, the new matter including the sources of the solubility data (given in an Authors' Index), freezing-point data, the methods of determining solubilities, and the calculation of solubility data in any desired terms. The order of arrangement of the inorganic and the organic substances is entirely alphabetical, which renders the book very easy to consult for information of the solubility of any desired substance. With this arrangement a Subject Index appears at first sight superfluous. Its value, however, is twofold. A substance such as phenol, for example, is mentioned many times, sometimes as solute, sometimes as solvent; as solute it appears under "P," whilst references to its use as solvent are given in the Subject Index. Again, synonymous names appear, not in the alphabetical list, but only in the index, where, for example, under "acetphenetide" reference is given to "phenacetin." Great care has been taken in gathering the solubility data, and, wherever possible, the composition of the solid phase in equilibrium with the solution has been given. No attempt has been made to give information about the melting-point data of mixtures of metals (alloys) or minerals, the freezing-points of very dilute solutions, the solubility of gases in molten metals, the "solubility" of metals in solvents due to chemical action, solid solutions, or data for substances of unknown or variable composition.

The book will undoubtedly find a place in scientific institutions and in the laboratories of chemical factories where the value of research work is appreciated.

CLARENCE SMITH.

AN INTRODUCTION TO THE PHYSICS AND CHEMISTRY OF COLLOIDS. By EMIL HATSCHEK. Third Edition. Pp. 116. London: J. and A. Churchill, 1920. Price 4s. 6d. net.

This book is already so well and favourably known from the earlier editions that a brief notice of the appearance of a third edition is sufficient. Although more extended accounts on the subject are now available in English, Mr. Hatschek's work will hold its own on account of its practical character and the clearness and accuracy with which it is written. It can be heartily recommended to all who desire a brief and trustworthy introduction to this important and rapidly extending branch of science.

GEORGE SENTER.

A LABORATORY MANUAL OF ELEMENTARY COLLOID CHEMISTRY. By EMIL HATSCHEK. Pp. 135. London: J. and A. Churchill, 1920. Price 6s. 6d. net.

No one is better fitted than Mr. Hatschek to produce the first work on practical colloid chemistry. He has not only tested personally the methods described, but has experienced the difficulties of students in carrying them out, and as a result his book will prove indispensable to all interested in the study of this important subject.

The book is divided into nineteen chapters, and full directions are given for the preparation and examination of emulsoids, suspensoids, emulsions, and sols and gels of various types. The processes of dialysis, ultrafiltration, cataphoresis, and optical methods of examination of colloids are illustrated, as well as the electrolyte precipitation of suspensoid sols, the mutual precipitation of suspensoid sols, and the "protection" of colloids. Measurements of viscosity and the phenomenon of adsorption are also described. Most of the experiments can be carried out with the ordinary apparatus of a chemical laboratory, and the descriptions are clear and accurate. A considerable number of illustrations add to the value of the book. References to recent literature are given at the end of each section.

All advanced students of chemistry would be well advised to perform a selection of the experiments described in this book. GEORGE SENTER.

THE MANUFACTURE OF SUGAR FROM THE CANE AND BEET. By T. H. P. HERIOT. London: Longmans, Green and Co., 1920. Price 24s. net.

The manufacture of sugar is such a varied process that it is impossible in a limited space to deal with all the different methods and apparatus employed. The author sets out with the idea of giving an account of the scientific principles on which successful practice is dependent. Separate chapters are devoted to the study of the two chief sources of sugar—viz., the beetroot and sugar-cane—and to the necessary differences of treatment due to the differences in structure of the plants and in the composition of their juices. Refining of the raw sugars and disposal of the residues are also considered. It is pointed out how the beet-sugar producer has been greatly in advance of the cane-sugar producer in scientific investigation and the application of scientific methods. More work is now being done in research in some directions in the sugar-cane industry in Java and other parts of the world, but, generally speaking, the British cane-sugar producer has not realised the importance and absolute necessity of research in all departments connected with his work if he is to keep up with his competitors.

The book is largely a compilation from standard works on sugar manufacture, references to which are given in the text. In many cases, too much space is taken up in elaborate details which might, with advantage, have been better employed in more careful elucidation of the principles involved in the operations.

The language is often very loose and inexact. Split infinitives are frequent, and there is an irritating use of commas, and especially of semicolons, where they are not wanted.

A few examples of inaccuracies may be indicated: "The seed is the reproductive organ." "Each flower contains stamens and pistils, and are termed perfect flowers." Pollination and fertilisation are taken as synonymous. The whole of the botanical portion is weak, and requires revision.

In the preface the carbonatation process is properly so called, but throughout the text this is shortened to "carbonation." To be consistent, "sulphitation" might equally well have been called "sulphation."

It would be well for "decolourising" to be used for the process of removal of

colouring matters, and "bleaching" for their *oxidation or reduction* to colourless compounds, instead of making "bleaching" cover both processes.

On pp. 245-246 "heating-surface" is employed to mean three different things. First it is the *metal partition* between the steam and the liquid to be evaporated, then it is the *area of heated metal* in contact with the liquid, and finally it is the *metal surface* in contact with the steam.

On p. 277 the definition of the coefficient of supersaturation should be the inverse of what is stated.

On p. 285 the right-hand table does not add up to 100 as given.

It is surely a very loose statement (pp. 295-296) that *centrifugal force acts* only on one of the constituents, solid or liquid, in a centrifugal machine.

The illustration of the brasmoscope on p. 316 shows the vacuum and temperature in cm. and degrees C. respectively, while in the description inches and degrees F. are employed. Throughout the book there is no consistency in the units adopted, shillings per ton and dollars per 100 kilos being quoted, and degrees F. and degrees C., kilos and tons, are used indiscriminately.

On p. 324 the ratio of 100 dry solids : cane sugar is given as the purity, whereas it should be cane sugar $\times$ 100 : dry solids, as stated on p. 147. On p. 338, 1 part CaO to 1 part of sugar is said to form the soluble monocalcium saccharate, while on the next page 1 part of lime to 1 of sucrose is said to cause tricalcium saccharate to be precipitated.

The principles which underlie the methods of chemical control and analysis of sugar products are given, but the details are said to lie outside the scope of the work. Such an expression, however, as "88 per cent. net analysis" does not convey any definite idea to the non-expert without some information as to its meaning.

The book is too detailed in many parts for the general reader, and does not contain sufficient original matter or fresh treatment of the subject for the practical sugar manufacturer.

The printing is good, and for a book of reference it lies open conveniently flat, but the binding leaves much to be desired. H. MAIN.